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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

November 24, 1970

REPLY TO
ATTN OF: GP

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for
Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,533,093

Government or Corporate Employee : Grumman Aircraft Engineering Corp.
Bethpage, Long Island, New York

Supplementary Corporate Source (if applicable) :

NASA Patent Case No. : XMS-10984-1

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☒

No ☐

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words "... with respect to an invention of . . ."

Elizabeth A. Carter
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Enclosure

Copy of Patent cited above

FACILITY FORM 602

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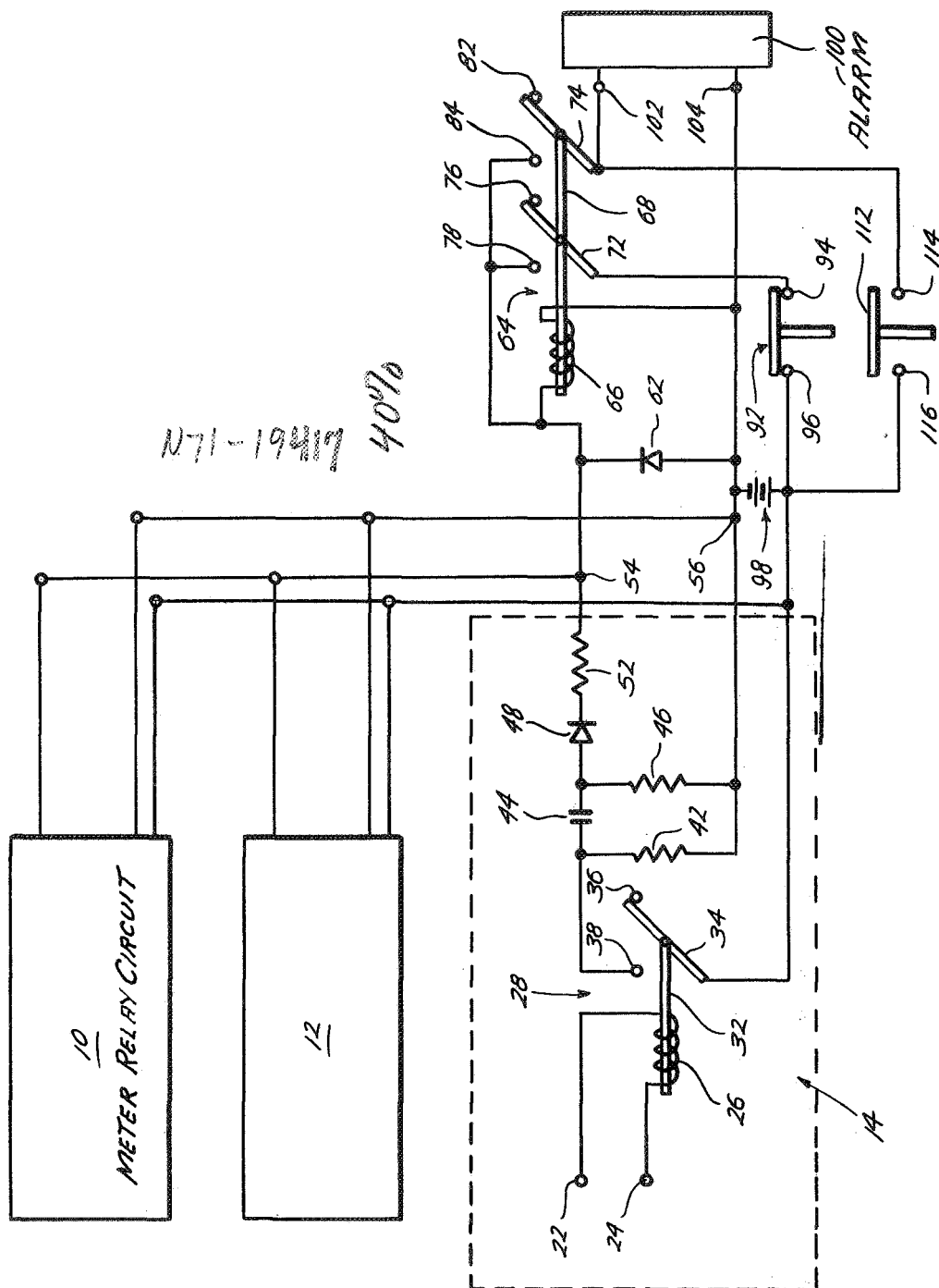
Oct. 6, 1970

JAMES E. WEBB
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3,533,093

OUT OF TOLERANCE WARNING ALARM SYSTEM FOR PLURALITY
OF MONITORED CIRCUITS

Filed Dec. 27, 1966



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OUT OF TOLERANCE WARNING ALARM SYSTEM FOR PLURALITY OF MONITORED CIRCUITS

James E. Webb, Administrator of the National Aeronautics and Space Administration, with respect to an invention of Urbano Bandini, Richmond Hill, N.Y.

Filed Dec. 27, 1966, Ser. No. 605,095

Int. Cl. G08b 25/00

U.S. Cl. 340-213.1

2 Claims

ABSTRACT OF THE DISCLOSURE

An alarm circuit for the purpose of monitoring one or more relay circuits so as to signal the closed condition of a monitored relay provides for the automatic initial energization of the alarm signal by one circuit and the continued energization and manual de-energization of the alarm signal by another circuit. So long as the monitored relay remains closed after the alarm signal has been manually de-energized, the initial energization circuit will not re-energize the alarm signal and will not do so for a predetermined period of time after the opening of the monitored relay. However, in the case of a plurality of relay circuits being monitored by a single alarm signal, the alarm may be energized by the closing of a second monitored relay even though the alarm had been previously de-energized by the manual control circuit and the first monitored relay is still closed.

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 U.S.C. 2457).

The invention relates in general to alarm circuits, and more particularly to multiple meter relay circuits utilizing a single alarm.

Meter relay circuits provide a contact closure when an out of tolerance condition exists. Where the closure is utilized merely as a warning in a circuit without initiating corrective action, it must be used to energize additional circuitry. When several meter relay circuits are grouped together to monitor a number of critical parameters, alarm provision must be made to allow continued warning capability while the relay having an out of tolerance condition thereacross has been disconnected from the alarm circuit.

In order to avoid overlapping effects caused by more than one contact closure at any one time, the alarm circuit of the present invention provides complete isolation for each meter relay circuit.

More particularly, the alarm circuit comprises a plurality of meter relay circuits. Each meter relay circuit comprises a relay which is energized when an out of tolerance condition occurs in a circuit associated with the respective meter circuit. The relay remains energized until the out of tolerance condition is corrected and simultaneously causes an alarm relay to become energized by connecting a D.C. power supply to the alarm relay through an R-C circuit. Energization of the alarm relay actuates an alarm circuit which may be audible or visual, or a combination thereof. An alarm stop switch is manually activated causing the alarm to become deactivated. Due to the R-C circuit in the meter relay circuit, the out of tolerance condition still existing in the meter relay circuit cannot cause the alarm relay to be actuated. However, should an out of tolerance condition cause the relay of another meter relay circuit to be energized, the alarm relay will once again become energized.

The advantage of this invention, both as to its construction and mode of operation, will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

FIG. 1 is a circuit diagram of a preferred embodiment of the present invention.

Referring now to the drawing, there is shown in FIG. 1 a circuit diagram of the novel alarm system. A plurality of identical meter relay circuits depicted as 10, 12, and 14 are each utilized to determine an out of tolerance condition in a respective circuit.

Each of the relay circuits 10, 12, and 14 are identical and may be described by reference to the detailed relay 14. The relay circuit 14 comprises a pair of input terminals 22, 24, which are connected across the coil 26 of a relay 28. The relay 28 further comprises an armature 32 having a contacting arm 34 and a pair of contact points 36, 38. With the relay 28 de-energized, the arm 34 is connected to point 36. Upon energization of relay 28, arm 34 is connected to point 38.

The relay circuit 14 further comprises a first resistor 42 and a capacitor 44 which are connected at one side to the terminal 38. The other side of capacitor 44 is connected to one side of a resistor 46 and to the anode of a D.C. blocking diode 48. The cathode of diode 48 is connected through a second resistor 52 to a first relay circuit first output terminal 54, and the other side of resistors 42 and 46 being connected to a first relay circuit second output terminal 56.

The alarm circuit comprises a damping diode 62 whose cathode is connected to first output terminal 54 and whose anode is connected to second output terminal 56. The alarm circuit further contains a holding relay 64 having a coil 66 connected across the output terminals 54, 56. The relay 64 further comprises an armature 68 having a first contacting arm 72 and a second contacting arm 74. With the relay 64 de-energized, one side of contacting arm 72 is connected to a first contacting terminal 76, and when relay 64 is energized, the arm 72 is connected to a second contacting terminal 78. Similarly, the arm 74 is connected to a first contacting terminal 82 when the relay 64 is de-energized and connected to a second contacting terminal 84 when the relay 64 is energized.

A normally closed "momentary OFF" alarm stop switch 92 has a first terminal 94 connected to the contacting arm 72 and a second terminal 96 connected to the positive side of a D.C. power supply 98. The negative side of the D.C. power supply is connected to the output terminal 56.

An audible or visual alarm 100 having a pair of input terminals 102, 104 is connected at its input terminal 102 to the arm 74 and at its input terminal 104 to the output terminal 56. Further, a normally open "momentary ON" alarm test switch 112 has a first terminal 114 connected to the terminal 102 and a second terminal 116 connected to the positive side of the D.C. power supply. The switch 112 is used to check the alarm 100 by periodically manually energizing the alarm.

With the foregoing in mind, operation of the circuit of FIG. 1 is as follows:

When an out of tolerance exists in the condition being monitored by the relay circuit 14, a sufficient signal exists across the terminals 22, 24 to energize relay 28 and cause contact arm 34 to move from point 36 to point 38. Movement of arm 34 to point 38 impresses the D.C. voltage source 98 across the winding 66 of relay 64 through a path comprising contact arm 34, point 38, capacitor 44, diode 48, and resistor 52; the capacitor 44 initially appearing as a short circuit to the D.C. source 98 when the relay 28 is energized. Energization of the relay 64 causes arms 72 and 74 to contact points 78 and

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84, respectively. The contacting of point 84 by the arm 74 causes the alarm 100 to be energized. Further, contacting of the arm 72 to the point 78 connects the D.C. voltage source directly across the relay 66. The capacitor 44, which is charging up to the D.C. voltage source 98 with a time constant

$$TC = \frac{C_{44} R_{46} R_{52}}{R_{46} + R_{52}}$$

or

$$TC = C_{44} R_{52}$$

where:

C_{44} is the capacitance of capacitor 44;

R_{46} is the resistance of resistor 46; and

R_{52} is the resistance of resistor 52 if resistor 46 is much greater than resistor 52.

Momentarily opening switch 92 turns off the alarm 100 by opening relay 64 and even though arm 34 is connected to point 38, the charged-up capacitor 44 now prevents reenergization of relay 64. However, an out of tolerance in the other meter relay circuits such as 10 or 12 connected to the alarm circuit will be able to start the cycle again.

When the out of tolerance condition of meter 14 has been removed, relay 28 is de-energized and capacitor 44 starts to discharge with a time constant

$$T_D = C_{44}(R_{42} + R_{46})$$

Where:

C_{44} is the capacitance of capacitor 44;

R_{42} is the resistance of resistor 42, and

R_{46} is the resistance of resistor 46.

The alarm circuit cannot respond again to another out of tolerance condition in meter 14 until capacitor 44 discharges sufficiently to permit energization of relay 64 through capacitor 44 (approximately $2T_D$). This delay feature allows time for minor adjustments to be made without having the alarm 100 operate continuously or as a result of transient out of tolerance conditions.

Typical component values for the circuit of FIG. 1 are as follows:

Capacitor 44—100 μ f., 50 volt

Resistor 42—100,000 ohm; $\frac{1}{2}$ watt

Resistor 46—100,000 ohm; $\frac{1}{2}$ watt

Resistor 52—68 ohm; 1 watt

Diode 48—1N3611

Diode 62—1N3611

Relay 28—Type MS 25321-D2

Relay 64—Type MS 25321-D2

Battery 98—28 volts D.C.

It should be further understood that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

In the claims:

1. A system having a warning alarm for signalling an out of tolerance condition in a plurality of monitored circuits comprising:

meter relay means associated with each monitored circuit, winding means of said meter relay means being energized when an out of tolerance condition exists in a respective one of said monitored circuits and being de-energized when an out of tolerance condition no longer exists in said respective monitored circuit; a source of electric energy;

alarm relay means for energizing said warning alarm when the meter relay means associated with said re-

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spective monitored circuit is energized, said alarm relay means comprising first and second contacting arm means, said first contacting arm means connecting said source of electric energy across the actuating winding of said alarm relay means, and said second contacting arm means connecting said source of electric energy across said warning alarm when said alarm relay means is energized;

an R-C coupling network respective to each meter relay means;

circuit means serially connecting said network and a switch component of said meter relay means, said network and switch component connected in series between said energy source and said alarm relay winding to initially energize said alarm relay winding when said one of said windings of said meter relay means is energized by said respective monitored circuit, said series connected switch component and R-C network respective to each monitored circuit being arranged in parallel with each other between said energy source and said alarm relay winding;

an interrupting switch means between said first contacting arm and said energy source for de-energizing said alarm relay means and;

a capacitor means in each R-C network adapted to prevent the re-energization of said alarm relay means after the opening of said interrupting switch means and while the meter relay switch responsible for originally energizing said alarm relay means is closed.

2. An electrical system for monitoring a plurality of electrical circuits comprising:

electrically operated warning alarm means;

a source of electric energy;

meter relay means comprising normally open switch means actuated by electromagnetic winding means being operatively associated with each of a plurality of monitored electrical circuits whereby an out of tolerance condition in a particular one of said monitored circuits causes the energization of the associated meter relay winding means thereby closing the respective switch means;

alarm relay means comprising normally open first and second switch means actuated by electromagnetic winding means;

a plurality of first circuit means connected between said electric energy source and said alarm relay winding means, each one of said plurality of first circuit means constituting separate energy flow paths and connected in parallel circuit relation to each of the other first circuit means, each one of said first circuit means comprising a respective one of said meter relay switch means and a respective R-C network means serially connected with said respective meter relay switch means;

second circuit means connecting said electric energy source to said alarm relay winding means through normally closed independent switch means and said alarm relay first switch means; and,

third circuit means connecting said electric energy source to said warning alarm means through said independent switch means and said alarm relay second switch means; whereby,

the closure of a particular meter relay switch means initially energizes said alarm relay winding means via said respective first circuit energy flow path to close said first and second alarm relay switch means, the continued energization of said alarm relay winding means being carried by said second circuit means; and, after said alarm relay winding means has been de-energized by the opening of said second circuit independent switch means, said R-C network means prevents the re-energization of said alarm relay winding means for so long as an out of tolerance condition in said particular monitored circuit causes the con-

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tinuous energization of said meter relay winding means.

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